Chapter 31 VALVE & SEAT SERVICE

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This engine systems course or class provides complete coverage of the components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and NATEF and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Real World Fixes, Videos, Animations, and NATEF Task Sheet references.
Motivate Learners	Explain how the knowledge of how something works translates into the ability to use that knowledge to figure why the engine does not work correctly and how this saves diagnosis time, which translates into more money.
State the learning objectives for the chapter or course you are about to cover and explain this is what they should be able to do as a result of attending this session or class.	Explain the chapter learning objectives to the students as listed on the NEXT SLIDE. 1. Prepare for ASE Engine Repair (A1) certification test content area "B" (Cylinder Head and Valve Train Diagnosis and Repair). 2. Discuss various engine valve types and materials. 3. Describe how to test valve springs. 4. Explain the purpose, function, and operation of valve rotators. 5. List the steps necessary to reface a valve. 6. Describe how to reface or replace valve seats. 7. Discuss how to measure and correct installed height and valve stem height.
Establish the Mood or Climate	Provide a ***WELCOME,*** Avoid put downs and bad jokes.
Complete Essentials	Restrooms, breaks, registration, tests, etc.
Clarify and Establish Knowledge Base	Do a round robin of the class by going around the room and having each student give their backgrounds, years of experience, family, hobbies, career goals, or anything they want to share.

ICONS	Chapter 27 Valve/Seat Service
	**1. SLIDE 1 CH27 VALVE & SEAT SERVICE** **2. SLIDES 2-3 EXPLAIN Objectives & KEY TERMS**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE IS UPDATED REGULARLY**
	**4. SLIDE 4 EXPLAIN** Intake and Exhaust Valves & **EXPLAIN FIGURE 27-1** Identification of parts of a valve. **5. SLIDE 5 EXPLAIN** Intake and Exhaust Valves & **EXPLAIN FIGURE 27-2** Typical valve spring and related components. Dual valve springs are used to reduce valve train vibrations and a spring seat is used to protect aluminum heads. **6. SLIDE 6 EXPLAIN FIGURE 27-3** intake valve is larger than the exhaust valve because the intake charge is being drawn into the combustion chamber at a low speed due to differences in pressure between atmospheric pressure and the pressure (vacuum) inside the cylinder. The exhaust is actually pushed out by the piston and, therefore, the size of the valve does not need to be as large, leaving more room in the cylinder head for the larger intake valve.
	**7. SLIDE 7 EXPLAIN TECH TIP**
	**HANDS-ON TASK: Give students an intake valve and have them identify its various parts**
	**Show ANIMATION: VALVE PARTS www.myautomotivelab.com** http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/A1_Animation/Chapter27_Fig_27_1/index.htm
	**DEMONSTRATION: Show some examples of defective valves such as those that are broken, burnt, and cracked.**
	**DEMONSTRATION: Show differences between exhaust and intake valves**

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	8. **SLIDE 8** EXPLAIN **FIGURE 27-4** Inertia welded valve stem and head before machining.
	**Show ANIMATION: VALVE COMPONENTS INSTALLED** **www.myautomotivelab.com** http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/A1_Animation/Chapter27_Fig_27_7/index.htm
	9. **SLIDE 9** EXPLAIN **FIGURE 27-5** A sodium-filled valve uses a hollow stem, which is partially filled with metallic sodium (a liquid when hot) to conduct heat away from the head of the valve.
	10. **SLIDE 10** EXPLAIN WARNING
	**HANDS-ON TASK: Pass around an alloy valve and a Stellite® valve together with magnet and ask the students to identify which valve is the alloy valve and which is the Stellite® valve.**
	11. **SLIDE 11** EXPLAIN Valve Seats & EXPLAIN **FIGURE 27-6** Integral valve seats are machined directly into the cast-iron cylinder head and are induction hardened to prevent wear.
	12. **SLIDE 12** EXPLAIN **FIGURE 27-7** Insert valve seats are a separate part that is interference fitted to a counterbore in the cylinder head.
	**DEMONSTRATION: Show the students examples of heads with integral seats and insert seats.**
	13. **SLIDE 13** EXPLAIN **FIGURE 27-8** Typical intake valve seat wear.
	14. **SLIDE 14** EXPLAIN **FIGURE 27-9** Carbon deposits on the intake valve are often caused by oil getting past the valve stems or fuel deposits.
	15. **SLIDE 15** EXPLAIN **FIGURE 27-10** Excessive wear of the valve stem or guide can cause the valve to seat in a cocked position.
	16. **SLIDE 16** EXPLAIN **FIGURE 27-11** Valve face guttering caused by thermal shock.

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	**DEMONSTRATION: Show the students examples of various valves with defects and explain the causes.**
	**HANDS-ON TASK: Have the students use service information to determine whether the OEM has recommended procedure for removing carbon deposits from valves without removing the cylinder heads from engine.**
	**17. SLIDE 17 EXPLAIN FIGURE 27-12** Note broken piston caused by a valve breaking from the stem.
	**DISCUSSION: Ask the students what the best method would be of determining whether a valve is leaking. (Answer: cylinder leakage test)**
	**DEMONSTRATION: Show the students an example of a valve failure caused by thermal shock.**
	**DEMONSTRATION: On an engine with adjustable valves show students how to adjust valve lash.**
	**HANDS-ON TASK: On an engine with adjustable valves have students adjust valve lash to meet specifications.**
	**18. SLIDE 18 EXPLAIN VALVE SPRINGS & FIGURE 27-13** A retainer and two split keepers hold the spring in place on the valve. A spring seat is used on aluminum heads. Otherwise, the spring seat is a machined area in the head
	**19. SLIDE 19 EXPLAIN TECH TIP**
	**20. SLIDE 20 EXPLAIN TECH TIP**
	**21. SLIDE 21 EXPLAIN FIGURE 27-14** Valve spring types (*left to right*): coil spring with equally spaced coils; spring with damper inside spring coil; closely spaced spring with a damper; taper wound coil spring.
	**22. SLIDE 22 EXPLAIN FREQUENTLY ASKED QUESTION**

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	**23. SLIDE 23 EXPLAIN FIGURE 27-15** Valve springs maintain tension in the valve train when the valve is open to prevent valve float, but must not exert so much tension that the cam lobes and lifters begin to wear. **24. SLIDE 24 EXPLAIN FIGURE 27-16** All valve springs should be checked for squareness by using a square on a flat surface and rotating the spring while checking. The spring should be replaced if more than 1/16 in. (1.6 mm) is measured between the top of the spring and the square. **25. SLIDE 25 EXPLAIN FIGURE 27-17** One popular type of valve spring tester used to measure the compressed force of valve springs. Specifications usually include (1) free height (height without being compressed), (2) pressure at installed height with the valve closed, and (3) pressure with the valve open to the height specified.
	**Show VIDEO: CHECKING VALVE SPRING PRESSURE: 1.3 Minutes** **www.myautomotivelab.com** http://media.pearsoncmg.com/ph/chet/chet_mylabs/akamai/template/video640x480.php?title=Checking%20Valve%20Springs&clip=pandc/chet/2012/automotive/Engines/A1T3.mov&caption=chet/chet_mylabs/akamai/2012/automotive/Engines/xml/A1T3.xml
	**DEMONSTRATION: Show students how to test valve spring tension and height using a valve spring tester.**
	**HANDS-ON TASK: Have the students check various valve springs for squareness and determine whether they meet specifications.**
	**ON-VEHICLE NON-NATEF TASK: Inspect valve springs for squareness and free height; determine necessary action.**
	**HANDS-ON TASK: With valve springs and a valve spring tester, have students test springs for tension & height and determine whether they meet specifications.**
	**26. SLIDE 26 EXPLAIN VALVE KEEPERS & FIGURE 27-18** Valve keepers (locks) are tapered so they wedge into a tapered hole in the retainer. **27. SLIDE 27 EXPLAIN FIGURE 27-19** Notice that there is no gap between 2 keepers (ends butted together). As a result, valve is free to rotate because retainer applies a force, holding keepers in place but not tight against stem of valve.

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	Most engines, however, do not use free rotators and, therefore, have a gap between the keepers.
	28. **SLIDE 28 EXPLAIN FIGURE 27-20** Type of valve rotator operation. Ball-type operation is on the left and spring-type operation is on the right.
	**DISCUSSION: Ask students why rotating valves is beneficial.**
	**DEMONSTRATION: Show students some examples of valve rotators**
	29. **SLIDES 29-30 EXPLAIN** Valve Reconditioning Procedure
	31. **SLIDE 31 EXPLAIN FIGURE 27-21** Resurfacing face of a valve. Both the valve and the grinder stone or disc are turned to ensure a smooth surface finish on face of valve.
	32. **SLIDE 32 EXPLAIN** Valve Face Grinding & **EXPLAIN FIGURE 27-22** Never use a valve that has been ground to a sharp edge. This weakens the valve and increases the chance of valve face burning.
	33. **SLIDE 33 EXPLAIN TECH TIP**
	34. **SLIDE 34 EXPLAIN FIGURE 27–23** After grinding the 45-degree face angle, additional airflow into the engine can be accomplished by grinding a transition between the face angle and the stem, and by angling or rounding the transition between the margin and the top of the valve
	35. **SLIDE 35 EXPLAIN** Valve Seat Reconditioning
	36. **SLIDE 36 EXPLAIN** Valve Seat Reconditioning **& FIGURE 27-24** Grinding 45-degree angle establishes valve seat in combustion chamber.
	37. **SLIDE 37 EXPLAIN FIGURE 27-25** Some vehicle manufacturers recommend that the valve face be resurfaced at a 44-degree angle and the valve seat at a 45-degree angle. This 1-degree difference is known as the interference angle.
	**DISCUSSION: Ask the students why an interference angle is often used between valve face and valve seat.**

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	**38. SLIDE 38 EXPLAIN FIGURE 27-26** seat must contact evenly around valve face. For good service life, both margin & overhang should be at least 1/32 in (0.8 mm). **39. SLIDE 39 EXPLAIN FIGURE 27-27** Grinding a 60-degree angle removes metal from the bottom to raise and narrow the seat. **40. SLIDE 40 EXPLAIN FIGURE 27-28** Grinding a 30-degree angle removes metal from top to lower and narrow the seat. **41. SLIDE 41 EXPLAIN FIGURE 27-29** typical three-angle valve job using 30-, 45-, and 60-degree stones or cutters.
	**DEMONSTRATION: Using a valve grinder, show how to grind the valves ensuring that they meet OEM specifications.**
	**HANDS-ON TASK: With a valve, and proper tools and equipment have students grind valve according to OEM specifications.**
	**HANDS-ON TASK: Have students look up valve face and valve seat angles in service information.**
	**42. SLIDE 42 EXPLAIN Valve Guide Pilots & EXPLAIN FIGURE 27-30** valve guide pilot being used to support a valve seat cutter**.**
	**DEMONSTRATION: Show difference between tapered pilot and expandable pilot**
	**43. SLIDE 43 EXPLAIN** Valve Seat Grinding Stones & **EXPLAIN FIGURE 27-31** Checking valve seat concentricity using a dial indicator. **44. SLIDE 44 EXPLAIN FIGURE 27-32** Typical dial indicator type of micrometer for measuring valve seat concentricity. **45. SLIDE 45 EXPLAIN FIGURE 27-33** After the valve face and the valve seat are ground (reconditioned), lapping compound is used to smooth the contact area between the two mating surfaces. Notice that contact is toward top of face. For maximum life, contact should be in middle of face.

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DEMO	**DEMONSTRATION: Show differences between 30-degree, 45-degree, & 60-degree stones**
DEMO	**DEMONSTRATION: Show how to dress the grinding stone.**
	HANDS-ON TASK: Have the students dress grinding stone.
DEMO	**DEMONSTRATION: Show proper procedure to grind the valve seat.**
	HANDS-ON TASK: Have the students grind 1 or 2 valve seats
	ON-VEHICLE NON-NATEF TASK: Inspect Valves and Valve Seats; Determine necessary action.
	46. **SLIDE 46** EXPLAIN Valve Seat Testing & EXPLAIN **FIGURE 27-34** A cutter is used to remove metal and form the valve seat angles.
DEMO	**DEMONSTRATION: how to ensure that valve seat is concentric using dial indicator.**
DEMO	**DEMONSTRATION: Show students how to use a valve seat cutter to recondition valve seat.**
	HANDS-ON TASK: Have students cut a valve seat using a valve seat cutter.
	47. **SLIDE 47** EXPLAIN Valve Seat Replacement 48. **SLIDE 48** EXPLAIN **FIGURE 27-35** All aluminum cylinder heads use valve seat inserts. If an integral valve seat (cast-iron head) is worn, it can be replaced with a replacement valve seat by machining a pocket (counterbore)

to make a place for the new insert seat

49. **SLIDE 49** EXPLAIN TECH TIP

50. **SLIDE 50** EXPLAIN **Figure 31-36** Insert valve seats are rings of metal driven into the head

51. **SLIDE 51** EXPLAIN TECH TIP

HANDS-ON TASK: Have students remove a valve seat insert without damaging cylinder head.

52. **SLIDE 52** EXPLAIN Valve Stem Height & EXPLAIN **FIGURE 27-37 V**alve stem height is measured from the spring seat to the tip of the valve after the valve seat and valve face have been refinished. If the valve stem height is too high, up to 0.02 in. can be ground from the tips of most valves.

53. **SLIDE 53** EXPLAIN **FIGURE 27-38** Installed height is determined by measuring the distance from the spring seat to the bottom of the valve spring retainer.
54. **SLIDE 54** EXPLAIN **FIGURE 27-39** Valve spring inserts are used to restore proper installed height.

Show VIDEO: VALVE SPRING INSTALLED HEIGHT: 1.13 Minutes
www.myautomotivelab.com
http://media.pearsoncmg.com/ph/chet/chet_mylabs/akamai/template/video640x480.php?title=Checking%20Valve%20Spring%20Install%20Height&clip=pandc/chet/2012/automotive/Engines/A1T6.mov&caption=chet/chet_mylabs/akamai/2012/automotive/Engines/xml/A1T6.xml

DEMONSTRATION: Show the students how to correctly measure installed valve spring height.

HANDS-ON TASK: Have the students measure installed valve stem height and determine whether it meets specifications.

ON-VEHICLE NON-NATEF TASK: Check valve spring assembled height and valve stem height; determine necessary action.

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	**55. SLIDE 55 EXPLAIN** Valve Stem Seals & **EXPLAIN FIGURE 27-40** Engine vacuum can draw oil past the valve guides and into the combustion chamber. The use of valve stem seals limits the amount of oil that is drawn into the engine. If the seals are defective, excessive blue (oil) smoke is most often observed during engine start-up. **56. SLIDE 56 EXPLAIN FIGURE 27-41** Engine oil can also be drawn past the exhaust valve guide because of a small vacuum created by the flow of exhaust gases. Any oil drawn past the guide would simply be forced out through the exhaust system and not enter the engine. Some engine manufacturers do not use valve stem seals on the exhaust valves.
	**DISCUSSION: Ask the students what function of the valve stem seal is.**
	**Leaking valve stem seals usually cause a vehicle to exhibit excessive blue smoke Immediately after startup due to the oil leaking down the valve stems while the engine is off.**
	**57. SLIDE 57 EXPLAIN FIGURE 27-42** Umbrella seals install over the valve stems and cover the guide.
	**DEMONSTRATION: Show difference between an umbrella seal & O-ring type seal.**
	**58. SLIDE 58 EXPLAIN FIGURE 27-43** A small square cut O-ring is installed under the retainer in a groove in the valve under the groove(s) used for the keepers (locks). **59. SLIDE 59 EXPLAIN FIGURE 27-44** Positive valve stem seals are the most effective type because they remain stationary on the valve guide and wipe the oil from the stem as the valve moves up and down. **60. SLIDE 60 EXPLAIN FIGURE 27-45** The positive valve stem seal is installed on the valve guide. **61. SLIDE 61 EXPLAIN FIGURE 27-46** An assortment of shapes, colors, and materials of positive valve stem seals.
	**62. SLIDE 62 EXPLAIN TECH TIP**

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	**63. SLIDE 63** EXPLAIN TECH TIP
	**HANDS-ON TASK:** Have the students search service information on a given vehicle for the correct procedure for replacing valve stem seals with the cylinder head on the engine.
	**DISCUSSION:** Ask the students what advantages are of using Viton valve stem seals versus Nitrile.
	**DEMONSTRATION:** Show the students examples of Nitrile, Viton, & polyacrylate valve stem seals.
	**64. SLIDES 64-65** EXPLAIN Installing the Valves
	**66. SLIDE 66** EXPLAIN **FIGURE 27-47** A metal valve spring seat must be used between the valve spring and aluminum cylinder head. Many Chrysler aluminum cylinder heads use a combination valve spring seat and valve stem seal. **67. SLIDE 67** EXPLAIN **FIGURE 27–48** Assembling a race engine using a heavy-duty valve spring compressor
	**Show VIDEO: INSTALLING VALVE SEALS www.myautomotivelab.com 1.46 Minutes** http://media.pearsoncmg.com/ph/chet/chet_mylabs/akamai/template/video640x480.php?title=Installing%20valve%20seals&clip=pandc/chet/2012/automotive/Auto_Parts_Specialist/Exp1.mov&caption=chet/chet_mylabs/akamai/2012/automotive/Auto_Parts_Specialist/xml/Exp1.xml
	**DEMONSTRATION:** Show the students how to install the valve, stem seal, valve spring, and valve keepers on a cylinder head using correct tools.
	**HANDS-ON TASK:** Have the students practice installing valve seals on a cylinder head using the correct service procedure and tools.
	**ON-VEHICLE NON-NATEF TASK:** Replace valve stem seals; inspect components; determine necessary action.
	**204. SLIDES 204-218** EXPLAIN **OPTIONAL INSTALLING A NEW VALVE SEAT**

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  	**SEARCH INTERNET:** Have students search Internet and find examples of valve failures. Have the students search Internet to find equipment used to grind valves. **Talk through SUMMARY and questions** **HOMEWORK:** complete Ch27 crossword puzzle: http://www.jameshalderman.com/links/book_engine_theory_serv_7/cw/crossword_ch_27.pdf